

BACKGROUND OF THE INVENTION

(a) Field of the Invention

This invention relates to textile material for use as the outer shell fabric of a firefighter garment. More particularly, the invention is
5 concerned with a lightweight outer shell fabric that is constructed of two different homogeneous yarn types in such a way as to increase resistance to mechanical and UV degradation while increasing thermal protective performance. In addition, the textile material can stretch, thereby increasing comfort and mobility.

10 (b) Description of Prior Art

All fabrics used in the manufacture of protective clothing for firefighters must satisfy minimum performance requirements for flame, heat and tear resistance as prescribed by the National Fire Protection Agency (NFPA).

15 A firefighter garment is normally made of a composite layer of materials including an outer shell fabric. All fabrics currently used for the outer shell fabric of firefighter garments are woven. The warps and wefts of the outer shell fabric usually comprise spun yarns that are either made up of homogeneous fibers or intimate blends of different fibers.
20 The purpose of using intimate blends of fibers in yarns is to combine the individual strengths of each of the constituent fibers. However, since each fiber has its own weaknesses as well as strengths, the resulting intimate blend yarn must necessarily have some performance compromises as well.

25 Many of the fibers used in the yarns used in outer shell fabric fabrics of firefighter garments have drawbacks: difficulty in absorbing dye stuffs, poor color retention, UV degradation, fibrillation, poor abrasion resistance.

The fabric may be constructed as a plain, ripstop, twill,
30 herringbone or other traditional weave construction; it will however,

appear as a continuous single sheet of yarns. And although there may be a face and a back surface to the weave construction, the face and back surfaces will consist of the identical yarns.

5 An alternative to spun yarns is multi-filamentary yarns. The latter have a much higher strength-to-weight and strength-to-denier ratios than the spun yarns of similar fibers. They are also more abrasion resistant and less water absorbing than spun yarns of the same fiber.

The principal disadvantages to multi-filamentary yarns are that the resulting fabrics are susceptible to yarn slippage.

10 The woven fabrics currently used as the outer shell fabric of fire protective garments, whether constituted of spun yarns, multi-filamentary or both, fray and ravel after being torn, cut or punctured. Fraying and raveling not only degrade the appearance of the garment, they make repairs more difficult, and they may increase the risk of
15 injury to the firefighter wearing the garment.

U.S. Pat. No. 5,299,602 discloses an outer shell fabric wherein the textile material comprises warps of alternating multi-filamentary aramid yarns and wefts of alternating spun aramid and multi-filamentary aramid yarns in a twill weave. The object of the invention disclosed in
20 that Patent was to increase firefighter comfort and mobility without reducing mechanical resistance. However, this fabric is still more vulnerable to yarn and seam slippage than fabrics made with 100% spun yarns. Also as a consequence of the high percentage of multi-filamentary yarns, the fabric ravels and frays when cut or torn.
25 Furthermore, the fabric has a preponderance of Kevlar[®] yarns on the face surface of the fabric and Kevlar[®] is more subject to mechanical and ultraviolet (UV) degradation than either spun or multi-filamentary Nomex[®].

U.S. Pat. No. 5,527,597 discloses a woven firefighter fabric that
30 incorporates a core-spun yarn (a Lycra[®] core protected by a

polybenzimidazole/aramid wrap) to impart a degree of elasticity to the fabric. Although the Patent claims that the fabric maintains its elasticity after five minutes at 500° F, the literature reveals that Lycra® is not thermally stable in firefighting environments: if stretched at
5 temperatures above 370-390° F., Lycra® will lose its elasticity; above 415° F., Lycra® begins to char and lose its properties. Therefore, this stretchable fabric would suffer irreversible degradation in a firefighting environment.

It is therefore an object of the present invention to provide a
10 stretchable fabric wherein the yarns such as aramid yarns would maintain their integrity at temperatures in excess of 600° F.

It is another object of the present invention to provide a textile material for the outer shell fabric of a firefighter garment that is lightweight yet has increased abrasion, tear, and UV resistance.

15 It is another object of the present invention to provide a textile material for the outer shell fabric of a firefighter garment that has a higher thermal protective performance rating than conventional fabrics of the same weight and fiber type.

It is another object of the present invention to achieve elasticity
20 through the inherent stretchiness of a warp knit construction and not through the introduction of thermally unstable elastomers.

It is a further object of the present invention to provide a warp knit textile material that can be used to produce a firefighter outer shell fabric that is more resistant to fraying and raveling than the currently
25 used woven fabrics.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a textile material to constitute an outer shell fabric for fire-resistive
30 garments, the textile material being a textile arrangement of at least first

(fill yarns). It would also be possible to provide interlacing common yarns in both the warp and the weft directions.

In another embodiment of the present invention, a warp-knit fabric, there are no weft yarns, only warp yarns. The warp yarns form continuously interlacing loops to make a length of fabric. In the warp-knit embodiment of the present invention multi-filamentary meta-aramid yarns are placed on one bar while spun or multi-filamentary para-aramid yarns are placed on a second bar. The loops of yarn from one bar are interlaced with loops of yarn from the other bar in a manner such that there is a preponderance of multi-filamentary meta-aramid yarn loops on the face surface and a preponderance of para-aramid spun or multi-filamentary yarn loops on the back surface.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated, but not restricted, by the annexed drawings of preferred embodiments in which

FIGURE 1 is an illustration in plan view on an enlarged scale of a conventional woven fabric of the prior art;

FIGURE 2 is an illustration in edge view on an enlarged scale of a double-weave fabric according to the invention for the outer shell fabric of a firefighter garment; and

FIGURE 3 is an illustration in plan view on an enlarged scale of the back surface of a warp knit fabric according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGURE 1, it will be seen that in a conventional woven fabric 10, the warp yarns 2 and the weft yarns 1 are of the same type of yarns, for example spun yarns and are of the same fiber composition, such as aramid, or an intimate blend of the same fibers.

